process. However, it produces a strong paper of a dense quality that is substantially air and moisture impermeable.

In the paper making process, raw cellulosic products such as wood, rags, recycled papers, etc., are subjected to the sulfate pulping process, followed by a bleaching procedure most frequently involving the use of hypochlorites and/or chlorine dioxide. After the raw cellulosic products are prepared into a slurry they are further broken down by pounding and refining processes and then mixed with fillers which improve the color and surface characteristics of the finished paper. Preferred filling materials include the aluminum silicates such as kaolin; china clay; titanium dioxides such as rutile and anatase; calcium carbonate; zinc oxide and/or zinc sulfide; calcium sulfate; hydrated aluminum talc; and barium sulfate. The fillers are generally added in quantities of about 1% to 5%–10% parts per weight of fiber material, and are added with more water in about 100–200 parts of water to 1 part of fibrous material. The mixture is constantly stirred with the addition of a sizing compound selected from the group including certain types of soaps, animal glues, starch paste, caseine or synthetic resin glues, latex products, or combinations of two or more of these. As previously mentioned, after the fibers are thus prepared they are laid out and brushed in mixed directions so that their arrangement leads to a tortuous path for microorganisms. The fibers must first be brushed in one direction to improve their mix, and then if the surface of the finished product is to be bonded with adhesive which can be peeled apart to open the package, the fibers must be then brushed in the same direction as the desired peel. However, as previously stated, this brushing step can be eliminated in papers produced according to the present invention. After mixture of the fibrous material with all of the fillers and binders, the pulp material is poured out on a screen (generally an endless wire screen) where it is dewatered, pressed, and calendered to obtain a smooth finish. It is in the steps of adding fillers and binding agents that the present invention is most pertinent.

The interfiber binding agents which are added to the cellulosic pulp material at the time the fillers and sizing additives are presented, are selected from a group including latex polyacrylamides, polyvinyl alcohols and other polymers which are receptive to the selected antimicrobial additive which is to be incorporated into the plastic matrices of the binder. The binding agents named above are conventional and are listed for exemplary purposes only, as the particular binder, apart from compatiblity with the antimicrobial additive, is not the point of novelty.

Once the polymeric binding agent has been selected, the selected antimicrobial additive is added to the base resin and the two are melted together and mixed; or the binding agent is put into solution using a compatible solvent, and then the antimicrobial additive is mixed therein. Upon mixing, the antimicrobial additive becomes incorporated in colloidal suspension within the amorphous zones of the polymeric matrices. Because the two compounds do not cross-link, reservoirs of the antimicrobial additive are formed within these amorphous zones, and become available to replenish the surface of the fibrous product as the supply of additive on the surface of the paper is removed.

Migration from the reservoir is created by destruction or removal of the surface supply of the antimicrobial additive. When the surface system is disturbed, internal vapor pressure on the reservoir causes a small fraction of the additive to migrate toward the surface. Proper migratory action ensures that the growth of bacteria is inhibited across the entire surface of the paper. The presence of moisture on or near the surface of the paper further enhances transfer of the antimicrobial additive because such moisture will soften the cell wall of the bacteria to assist penetration of the additive therethrough, whereupon the additive interferes with the metabolic functioning of the microorganism.

The antimicrobial agent selected for a given binding agent must be able to withstand the temperatures involved in the melting of the binding agent base resin. Further, the additive must be capable of colloidal suspension within the amorphous zones of the polymer as described above. Additives known to be compatible with a variety of contemplated polymers are the halogenated aeromatic nitriles (such as tetrachloroisophthalonitrile); Fungaflor, which is a salt of imazilil sulfate and a proprietary product of Janssen Pharmaceuticals; 3,5,3',4'-tetrachlorosalicylanilide (also known as Irgasan, a product of Ciba-Geigy Company); and dichlorophene (2,2'-methylenebis-4-chlorophenol, a product of the Givaudan Corporation). Of these additives, applicant prefers the use of tetrachloro-isophthalonitrile, and Irgasan. However, other antifungal and antibacterial agents not mentinoed above but which have these same characteristics of colloidal suspension within the polymer may be used.

The antimicrobial additives may be used alone or in combination with each other as active ingredients in the binding agents. The amount used is generally an arbitrary amount, depending on the requirements of a particular application and cost effectiveness. Preferred amounts arrange from 0.1% to 0.5% percentage by weight of the finished paper.

The resulting kraft-type papers have been shown to be effective against gram positive and gram negative bacterial growth and testing has indicated that the effectiveness lasts a substantial period beyond the normal life of the sterilized package made from the paper.

While other modifications of the product described above will be obvious to those skilled in the art, such modifications are believed to fall within the scope of the claims below.

What is claimed is:

1. An antimicrobial paper for packaging surgical supplies and other goods to be maintained in a sterile condition, said paper comprising:

(a) a slurry of paper forming fibers prepared according to a wetlaid process;

(b) a polymeric binding agent incorporated in said slurry, said binding agent being selected from the group containing acrylics, polyvinyl acetates, vinyl acetate-ethylenes, polyvinyl chlorides, and styrene-butadine latexes;

(c) an antimicrobial additive incorporated in said binding agent, said antimicrobial additive being non-crosslinked with said binding agent and forming reservoirs which reside in colloidal suspension within the amorphous zones of said binding agent and from which said antimicrobial additive migrates to the surface of said paper until the reservoir is exhausted;

(d) fillers selected from the group including aluminum silicates, titanium dioxide, calcium carbonates, zinc oxides, zinc sulfides, hydrated aluminum talc, calcium sulfate, and barium sulfate;